RESTRICTED

1.499 dup

PRELIMINARY INSTRUCTION BOOK

For

RADIO RECEIVING EQUIPMENT

MODEL RBH-2

Frequency Range	300 to 1200 Kcs. and 1700 to 16,000 Kcs.
Supply 115 Volts ±10%	50/62 Cycles Single Phase

~~Lot 5~~
Ed.
2 Copies

NAVY DEPARTMENT

Bureau of Ships

Sec 1740

Contractor

NATIONAL COMPANY, INC., MALDEN, MASS., U.S.A.

Manufactured by

NATIONAL COMPANY, INC., MALDEN, MASS., U.S.A.

Contract NXss-19881

Dated January 2, 1943

ADDENDA

DUMMY SOCKET J-102 and DC CABLE CONNECTOR PLUG P-102 have been omitted from all Navy Type CNA-46188 Radio Receivers after Serial No. 1150 supplied on contract NXs-738 for RBH-1 Equipments. The hole resulting from the removal of the DUMMY SOCKET J-102 is covered by a small metal plate. For DC operation of the Type CNA-46188 Radio Receiver the AC SUPPLY CONNECTOR PLUG P-103 should be used as a DC CABLE CONNECTOR PLUG by rewiring it to conform with plug P-102 as shown in the Schematic Diagram. These changes were authorized by Buships letter C-NXs-4681 (927) C-NXs-456 C-NXs-4683 C-NXs-738 Serial No. 187 dated June 15, 1943 to National Co.

The mechanism used to turn the main tuning capacitor assembly may be made to turn more or less freely as desired by adjustment of the friction introduced into the mechanism. The desired adjustment of mechanism friction is made by proper placement of the main tuning knob on its shaft. The main tuning knob is secured to its shaft by set screws. Adjustment of these set screws allows the knob to be moved closer to the receiver and then secured on its shaft which increases the mechanism friction and vice versa.

RESTRICTED

PRELIMINARY INSTRUCTION BOOK

For

RADIO RECEIVING EQUIPMENT

MODEL RBH-2

Frequency Range	300 to 1200 Kcs. and 1700 to 16,000 Kcs.
Supply 115 Volts ±10%	50/62 Cycles Single Phase

NAVY DEPARTMENT

Bureau of Ships

Contractor

NATIONAL COMPANY, INC., MALDEN, MASS., U.S.A.

Manufactured by

NATIONAL COMPANY, INC., MALDEN, MASS., U.S.A.

Contract NXss-19881 Dated January 2, 1943

RESTRICTED

This instruction book is furnished for the information of commissioned, warrant, enlisted and civilian personnel of the Navy whose duties involve design, instruction, operation and installation of radio and sound equipment. The word "RESTRICTED" as applied to this instruction book signifies that this instruction book is to be read only by the above personnel, and that the contents of it should not be made known to persons not connected with the Navy,

NOTICE

All material in this instruction book which refers to the Model RBH-1 Radio Receiving Equipment is also applicable to the Model RBH-2 Equipment.

GUARANTEE

All items used in this equipment, except vacuum tubes, will be guaranteed by the contractor for a period extending one year from the installation date of the equipment, provided that in no case will the guarantee extend longer than two years after the date of acceptance. This guarantee will cover items failing in normal operation and the contractor will replace these at no cost to the Government and with transportation charges prepaid to destination. If the contractor elects to have the defective unit returned to his plant for examination, he will be required to pay the transportation charges.

2-1-3 Two audio output circuits are provided:

(1) A headphone jack is mounted on the front panel. The correct load impedance for the headphone output circuit is 600 ohms. Maximum undistorted audio power output at the phone jack is approximately .3 watts. The headphone jack and output transformer are so wired that the circuit is balanced with respect to the receiver chassis.

(2) A pair of loud speaker output terminals are located at the rear of the chassis. These terminals are connected in parallel with the phone jack and therefore the characteristics of this circuit are the same as the characteristics of the phone jack circuit.

2-1-4 Antenna input terminals are located at the rear of the chassis near the center. The input circuit is suitable for operation with a single wire antenna, or an unbalanced transmission line.

2-1-5 The frequency range of the Type CNA-46188 Radio Receiver is from 300 to 1200 kilocycles and 1700 to 16,000 kilocycles. This range is covered in five working bands as follows:

300	-	600 Kilocycles
600	-	1,200 Kilocycles
1,700	-	3,900 Kilocycles
3,900	-	8,000 Kilocycles
8,000	-	16,000 Kilocycles

All radio frequency transformers and their associated trimmer capacitors are mounted in two cast aluminum catacombs having a total of twenty shielding compartments. Each R.F. transformer and its associated trimmer capacitors are mounted on a low-loss bakelite base fitted with contact pins which protrude from the coil catacomb. Manipulation of the band change knob slides the coil catacombs across the width of the chassis causing the contact pins of each set of R.F. transformers to engage, in turn, with contact springs mounted on the receiver chassis.

2-1-6 The Type CNA-46188 Radio Receiver has a dial with five scales calibrated in accordance with the frequency response of the five bands. The particular band in use is indicated by a band indicator dial which turns as the band selector knob is turned. In addition to the frequency calibrated scales, an auxiliary numerical dial is employed. This dial has 100 divisions and makes 10 revolutions while the tuning capacitor rotates 180 degrees; it is direct reading to one part in one thousand.

2-1-7 The power supply circuits provide 6.3 volts at 3.45 amperes for the heater circuit of the receiver and 290 volts (B+ to B-) at

55 milliamperes for the receiver B supply. A two-section filter is employed. When a DC supply is used it should be capable of supplying 6.3 volts at 3.45 amperes and 180 volts DC at 30 milliamperes.

2-2 The Type CNA-10125 Mounting Base is a shock-proof mounting base suitable for use with the type CNA-46188 Radio Receiver.

3. TUBE COMPLEMENT

3-1 The tubes employed in the Type CNA-46188 Radio Receiver are as follows:

SYMBOL (DWG.)	NAVY OR COMMERCIAL TYPE	FUNCTION
V-101	6K7	R.F. Amplifier
V-102	6K7	R.F. Amplifier
V-103	6J7	First Detector
V-104	6K7	First I.F. Amplifier
V-105	6K7	Second I.F. Amplifier
V-106A	6C8G	Second Detector
V-106B		Limiter
V-107A	6F8G	First Audio Amplifier
V-107B		Automatic Volume Control
V-108	6K6GT/G	Second Audio Amplifier
V-109	6J5	H.F. Oscillator
V-110	6J7	C.W. Oscillator
V-111	5Z3	Rectifier

4. POWER REQUIREMENTS

4-1 The Model RBH-1 Radio Receiving Equipment is built for operation from a 115 volt (±10%) 50/62 cycle AC power source. Normal power consumption is approximately 60 watts.

4-2 The 6.3 volt and 180 volt sources for DC operation must be electrically insulated from each other. See Par. 2-1-7.

5. ANTENNA REQUIREMENTS

5-1 The antenna input circuit of the Type CNA-46188 Radio Receiver is suitable for use with a single wire antenna, an unbalanced feed-line or a low impedance concentric transmission line. The impedance of the antenna or transmission line at the receiver input terminals should not be less than 70 ohms.

5-2 The antenna-ground terminal strip, E-101, is located at the rear of the chassis near the center. The binding post on the right as viewed from the rear is permanently connected to the re-

ceiver chassis. The binding post on the left as viewed from the rear is connected to one end of the antenna input coil in use; the other end of the antenna input coil is connected to the receiver chassis.

5-3 In an installation having a simple antenna-ground combination, connect the single wire lead-in to the binding post on the left as viewed from the rear. It is recommended that the Model RBH-1 Equipment be permanently grounded; the ground lead may be attached directly to the input terminal on the right which is connected to the chassis. The dimensions of the single wire antenna system are not at all critical: The recommended minimum overall length of antenna and lead-in is fifty feet; the recommended maximum overall length is two hundred feet.

5-4 In an installation having a concentric feed-line, connect the inner conductor to the left-hand input terminal and the outer conductor to the other input terminal.

6. INSTALLATION

6-1 Each major unit and the spare parts of the Model RBH-1 Radio Receiving Equipment is packed in one container.

6-2 After unpacking, the Type CNA-10125 Mounting Base should be securely fastened to the operating table and the Type CNA-46188 Radio Receiver secured to the Mounting Base.

6-3 For AC operation, connect the D.C. CABLE CONNECTOR PLUG P-102 to the DUMMY SOCKET J-102; connect the AC LINE PLUG P-101 to a 115 volt 50/62 cycle AC power source; connect the AC SUPPLY CONNECTOR PLUG P-103 to the POWER SOCKET J-103. These connections complete the necessary circuits for AC operation.

For DC operation, connect the AC SUPPLY CONNECTOR PLUG P-103 to the DUMMY CONNECTOR PLUG P-102 to the POWER SOCKET J-103, which completes the necessary circuits for DC operation. The cable associated with DC CABLE CONNECTOR PLUG P-102 must of course be connected to a 6.3 volt DC source for the heater circuit and a 180 volt DC source for the B supply. See Par. 2-1-7. The AC LINE PLUG P-101 need not be removed from the AC power source as these circuits are incomplete when connections are made for battery operation.

6-4 Make antenna connections in accordance with Section 5, "Antenna Requirements".

6-5 Before putting the receiver in operation, remove machine screw at the right-hand end of the chassis to release the band changing mechanism. This screw clamps the coil catacombs to the end of the chassis during shipment and should be saved if the equipment is to be repacked and reshipped.

6-6 If the installation is such that a Loud Speaker will be placed close to the receiver, the most desirable position is at the left-hand side. Placing the Loud Speaker on top of the receiver cabinet is the least desirable position since vibration from the speaker may introduce microphonic noises which would not otherwise be noticeable. Microphonic noise or "mechanical feed-back" can often be eliminated by reversing the speaker leads at the speaker output terminals of the receiver.

6-7 If a loud speaker is used, connect the leads of the loud speaker to the terminals E-102 of the receiver. Terminal E-104 is used for grounding a speaker cable shield if used.

7. NET WEIGHTS AND OVERALL DIMENSIONS

7-1 Net Weights

Type CNA-10125 Mounting Base.....	5-3/4 lbs.
Type CNA-46188 Radio Receiver.....	74 lbs.
Spare Parts, packed.....	20 lbs.
Total Weight of Equipment.....	99-3/4 lbs.

7-2 Overall dimensions of the Type CNA-46188 Radio Receiver, and Type CNA-10125 Mounting Base.

	Receiver and Mounting Base	Receiver
Depth, including panel controls....	17-7/8 in.	17-1/4 in.
Height.....	12-13/32 in.	10-21/32 in.
Width.....	17-21/32 in.	17-3/16 in.

8. OPERATING INSTRUCTIONS

8-1 Controls

8-1-1 All switches and controls (with the exception of the main tuning dial and the band selector knob) of the Type CNA-46188 Radio Receiver are identified by etched panel plates or dial scales. The symbol numbers in the following paragraphs of this Section refer to the Schematic Diagram and the Spare Parts List.

8-1-2 The main tuning dial is located at the center of the front panel of the receiver. The dial scale and pointer arrangement are described in Par. 2-1-6. The dial drive is so arranged that the frequency to which the receiver tunes increases with clockwise rotation of the tuning knob. The accuracy of calibration can be relied upon to plus or minus 3%.

8-1-3 The band selector knob is located near the bottom of the front panel at the center. The knob must be rotated approximately one and one half turns to change from one band to an adjacent band. A positive detent is provided to insure proper positioning of the coil contact pins in the contact springs.

8-1-4 The LIMITER control R-151, at the left-hand side of the receiver panel, is used to adjust the DC potential applied to the elements of the limiter tube V-106B. The limiter circuit is thus provided with an adjustable threshold at which limiting action starts. Any audio voltages, or peaks, in excess of this threshold are prevented from reaching the audio amplifier. With the LIMITER control set at 0, the limiter circuits will pass all but the strongest audio peak voltages; when the control is set at 10, the threshold is lowered to a point where the audio signal will be distorted due to suppression of the positive peaks.

8-1-5 The TONE control R-119, at the lower left-hand corner of the front panel, is used to vary the frequency characteristic of the audio amplifier. When the control is set at the position marked "N", the full audio frequency range of the receiver is available; in the HIGH position, audio frequencies below 100 cycles are attenuated; as the control is turned clockwise towards the LOW position, audio frequencies above 1000 cycles are increasingly attenuated.

8-1-6 At the left of the dial scale is located the POWER SUPPLY switch S-101A - S-101B. In the counterclockwise position, OFF, the receiver is turned off, the primary and heater circuits being opened by switch S-101A; in the mid-position, B+ OFF, switch S-101A is turned on but the B supply circuits are incomplete since switch S-101B is open; in the clockwise position, B+ ON, switch S-101B is closed, completing the B supply circuit. The B+ OFF position may thus be used for rendering the receiver inoperative, as may be required during periods of transmission.

8-1-7 A three-position CONTROL SWITCH S-102A-S-102B is located at the left of the dial below the POWER SUPPLY switch. In the AVC position, the automatic volume control circuits are in operation; in the MVC position, automatic volume control is turned off; in the CWO position, the CW oscillator is turned on and automatic volume control turned off.

8-1-8 At the right-hand side of the front panel is located the C.W. OSC. control, used for varying the frequency of the CW oscillator over a range of approximately 10 kilocycles. The CW oscillator is tuned to the intermediate frequency at 0 on the C.W. OSC. scale.

8-1-9 The A.F. GAIN control R-121 is located at the lower right-hand corner of the front panel. It is used to control the audio amplification of the receiver. Audio amplification increases as the control is turned clockwise towards 10 on the scale.

8-1-10 The R.F. GAIN control R-129 is located the lower right center of the front panel. It controls the amplification of the second R.F. amplifier tube V-102 and the two I.F. amplifier tubes V-104 and V-105. Amplification increases as the control is turned clockwise towards 10 on the scale.

8-1-11 At the right of the main tuning dial scale are located the crystal filter SELECTIVITY and PHASING controls C-122 and C-117, respectively. When the PHASING control is set at OFF, the crystal filter is disconnected. Turning the PHASING control from OFF to 1 switches in the filter by means of switch S-105. The PHASING control is used primarily for balancing the crystal bridge circuit and eliminating heterodynes, as explained under Par. 8-2-7.

8-1-12 The SELECTIVITY control is used primarily for adjusting the selectivity of the crystal filter after the filter has been switched into the circuit by means of the PHASING control. See Pars. 8-2-6 and 8-3-5. With the crystal filter disconnected, the SELECTIVITY control functions as a simple I.F. transformer tuning adjustment and should be set to provide maximum I.F. amplification, as explained in Par. 8-2-1.

8-1-13 At the upper left-hand side of the front panel is located the S-METER switch S-103. This switch must be pushed to the right when S-meter readings are to be made, as explained in Par. 8-4-1. At all other times, the S-meter should be disconnected by pushing the switch button to the left.

8-2 MCW Or Phone Reception

8-2-1 After the Model RBH-1 Equipment is properly installed in accordance with Section 6, it is put into operation by turning the POWER SUPPLY switch to the B+ ON position. The LIMITER control should be set at 0; the TONE control set at "N"; the R.F. GAIN control should be advanced to some position between 8 and 10, depending upon receiving conditions; the A.F. GAIN control should be set at the point providing the desired audio volume; the PHASING control should be set at OFF; the SELECTIVITY control should be adjusted to the setting which provides maximum background noise; the CONTROL SWITCH may be set either at the AVC or MVC positions. The receiver is now adjusted for stand-by or monitor service. Operated in this manner, the receiver will respond to signals over a band width of about 15 kilocycles. For general communications use see Par. 8-2-6.

8-2-2 With the CONTROL SWITCH in the MVC position, the operator must be careful not to advance the R.F. GAIN control to a point where I.F. or audio amplifier overload occurs. Such overload is indicated by excessive distortion. In general, it is recommended that the A.F. GAIN control be set partway on, i.e., at 1 or 2 and audio output adjusted by means of the R.F. GAIN control.

8-2-3 With the CONTROL SWITCH in the AVC position, the R.F.GAIN control should be advanced as far as receiving conditions permit, or until background noise becomes objectionably loud. Audio output should be adjusted entirely by means of the A.F. GAIN control. The operator must remember that automatic volume control action will be restricted unless the R.F. GAIN control is fully advanced.

8-2-4 If a signal is weak and partially obscured by background noise and static, best signal-to-noise ratio will be obtained by turning the TONE control towards the LOW position. The most effective setting must be determined by trial as too much attenuation of high audio frequencies will impair the intelligibility of the signal.

8-2-5 When a signal is accompanied by static peaks or noise pulses of high intensity and short duration, the best signal-to-noise ratio will be obtained by advancing the LIMITER control towards 10. The best setting must be determined by trial as too much limiter action will impair audio quality. If static peaks and noise pulses are extremely strong or if they are of fairly long duration, the effectiveness of the limiter will be best with the CONTROL SWITCH in the MVC position. In such cases both R.F. GAIN and LIMITER controls must be carefully adjusted for optimum signal-to-noise ratio.

8-2-6 In general communications reception, it is recommended that the selectivity of the receiver be increased by use of the crystal filter. The filter is switched into the circuit by setting the PHASING control at any position other than OFF. The normal setting of the PHASING control in MCW reception is at 5 on the scale. The normal setting of the SELECTIVITY control in MCW reception is at the position affording minimum selectivity. This position is near the middle of the selectivity scale and is that at which background noise is maximum. Selectivity may be further increased by turning the SELECTIVITY control in either direction from the minimum selectivity position.

8-2-7 The PHASING control is used to eliminate or attenuate heterodynes. If, after a signal has been tuned in, an interfering signal causes a heterodyne or whistle, the PHASING control should be adjusted until the heterodyne is reduced to a minimum. The setting of the PHASING control which provides maximum attenuation of the heterodyne will depend upon the pitch of the heterodyne whistle. If the heterodyne beat note is above 1000 cycles, the optimum PHASING control setting will be near mid-scale; if the beat note is 300 or 400 cycles, the optimum PHASING control setting will be near one end of the scale or the other, depending upon whether the interfering signal has a higher or lower frequency than the desired signal.

8-2-8 It is recommended that the TONE control be set in the HIGH position when using the crystal filter in MCW reception. The resulting attenuation of low audio frequencies tends to compensate for the side-band cutting action of the crystal filter and is helpful in eliminating low frequency flutter or "motorboating" which may be present when the receiver is not accurately tuned to the signal.

8-3 CW Reception

8-3-1 The initial adjustment of the Type CNA-46188 Radio Receiver for CW reception is as described in Par. 8-2-1, except that the CONTROL SWITCH must be in the CWO position. The C.W. OSC. control should be set at mid-scale.

8-3-2 The sensitivity of the receiver should be adjusted by means of the R.F. GAIN control, care being taken not to advance the control to the point where strong signals will cause I.F. or audio amplifier overload. Such overload is indicated by excessive distortion and by a change in pitch over the duration of a code character (dot or dash).

8-3-3 The action of the TONE and LIMITER controls will be similar to that described under Par. 8-2-4 and 8-2-5. When receiving CW signals, it will be possible to advance both TONE and LIMITER controls considerably further than is possible in MCW reception, since audio distortion is relatively unimportant.

8-3-4 Turning the C.W. OSC. control will change the characteristic pitch of the receiver background noise. The pitch will become higher as the CW oscillator is detuned from the I.F. amplifier. With the C.W. OSC. control set at 2 or 3, (on either side of 0) the characteristic pitch of the receiver background noise will be in the neighborhood of 2000 cycles. Under these conditions, the audio beat note of any CW signal will show a broad peak in output at approximately 2000 cycles. This peak will appear on "one side of the carrier" only and the other side, where the audio beat note is around 2000 cycles, will be considerably weaker. This characteristic is helpful in receiving weak signals through interference.

8-3-5 As stated in Par. 8-2-6, the selectivity of the receiver may be increased by means of the crystal filter. The action of the SELECTIVITY and PHASING controls will be similar to that described in Pars. 8-2-6 and 8-2-7. It may be desirable to utilize the full range of crystal filter selectivity in CW reception. Maximum selectivity is obtained with the SELECTIVITY control set at 0. With this setting the single-signal effect, outlined in Par. 8-3-4, becomes very pronounced; in other words, the audio beat note is very sharply peaked at a definite audio frequency which is determined by the setting of the C.W. OSC. control. The operator may have difficulty in finding the audio peak when first attempting to use the crystal filter. After a signal has been accurately tuned to give peak response, it is usually necessary to retard the R.F. GAIN control to prevent I.F. or audio overloading.

8-4 Measurement of Signal Strength

8-4-1 To make a measurement of signal strength by means of the S-meter, the R.F. GAIN control must be fully advanced, the CONTROL SWITCH in the AVC position and the S-meter switch S-103 pushed to the right to complete the meter circuit. The crystal filter should be turned off by means of the PHASING control, and the SELECTIVITY control set at maximum gain, as described in Par. 8-2-1. The adjustment of the TONE, LIMITER and A.F.GAIN controls is unimportant.

8-4-2 With no R.F. input to the receiver, or with the antenna disconnected, the S-meter should read 0, plus or minus 1 S-unit. If it does not, the S-meter circuit requires adjustment. This adjustment is made with the R.F. GAIN control fully advanced and with the CONTROL SWITCH in the MVC position. Variable resistor R-148 may then be set to bring the meter pointer to 0 on the scale. Turning the CONTROL SWITCH to the AVC position should not produce any meter deflection provided there is no R.F. input to the receiver.

8-4-3 In adjusting resistor R-148, due caution must be excercised to avoid electrical shock or a short-circuit to the chassis, since resistor R-148 is connected in the plate circuit of the second I.F. tube V-105. It is recommended that an insulated screw driver be used for making the adjustment.

8-4-4 Measurement of the signal strength of CW signals cannot be made with the CW oscillator in operation.

9. LOCATION OF TROUBLES

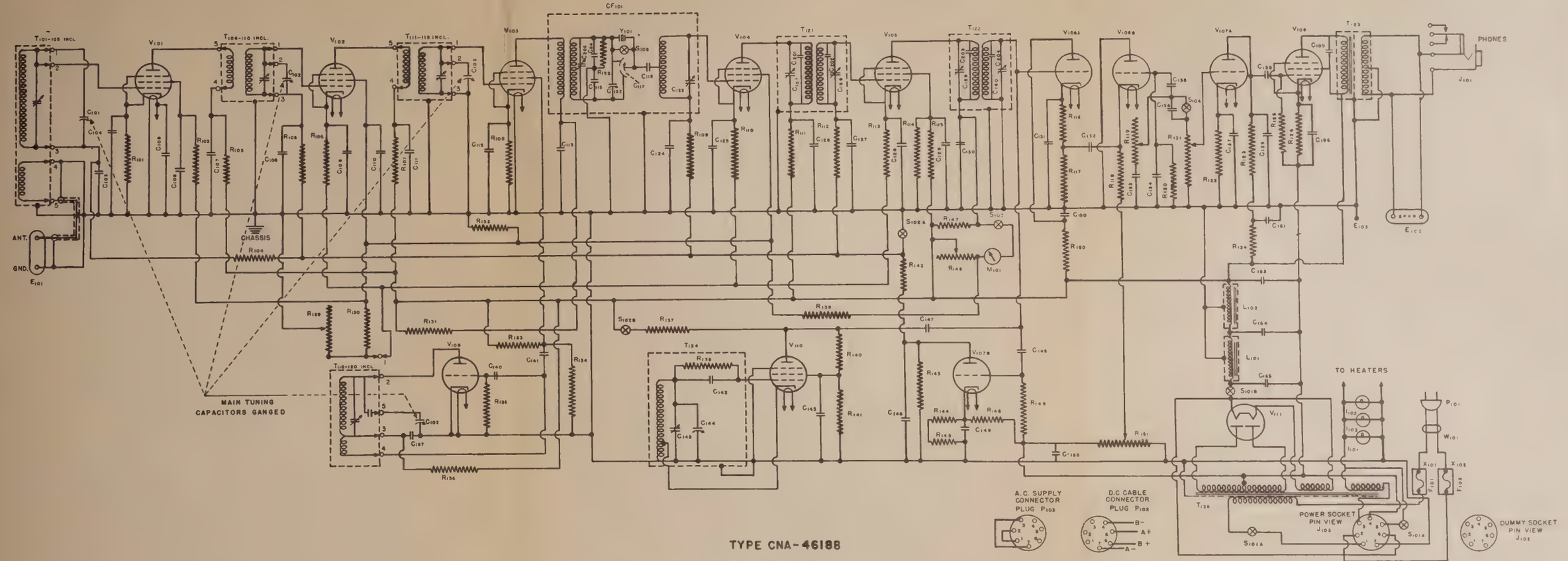
9-1 Failure of a vacuum tube in either the receiver or power unit may reduce the sensitivity of the equipment to radio signals, produce intermittent operation, or cause the equipment to be completely inoperative. In all cases of reduced sensitivity and noisy or intermittent operation, all tubes should be checked, preferably by replacement with tubes of proven quality. A poor connection in a tube can usually be found by lightly tapping the tube in question or jarring the receiver chassis with the equipment adjusted for normal operation.

9-2 A short-circuit between tube elements can cause damage to any filter resistors or voltage divider resistors associated with the defective tube. All such circuit components should be checked for possible change in resistance value.

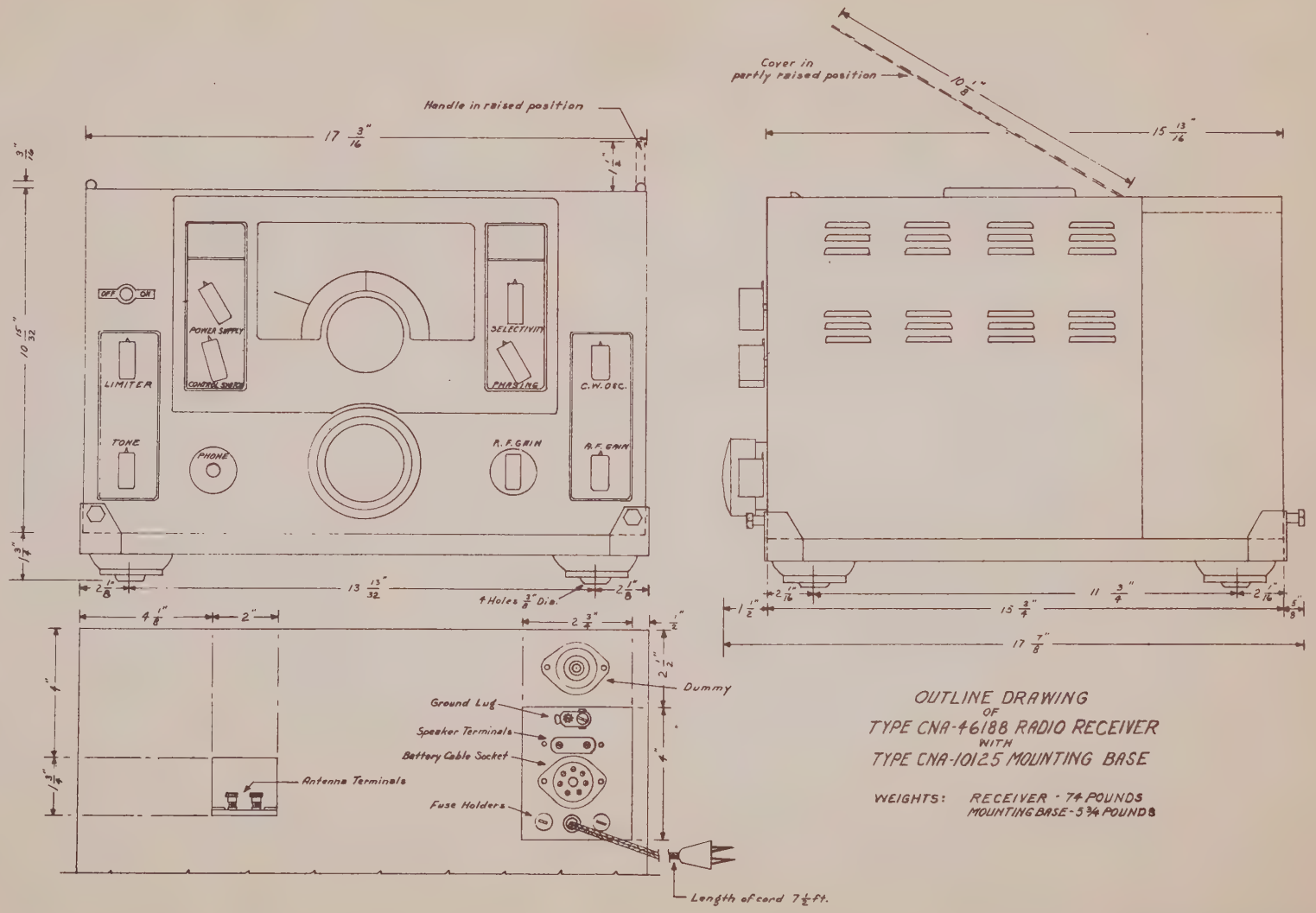
9-3 Failure of any by-pass or filter capacitor may seriously overload resistors of the associated circuits. Overloads of sufficient magnitude to permanently damage a resistor will cause the painted surface of the resistor to be scorched, making the defective unit easy to locate by visual inspection.

9-4 By-pass or filter capacitors which develop poor connections internally, or which become open circuited, will in most cases cause decreased sensitivity, oscillation, or affect the normal characteristics of the equipment. The defective unit can be located by temporarily connecting a good capacitor in parallel with each capacitor that is under suspicion.

ACTUAL WIRING DIAGRAM
MODEL RBH-1 EQUIPMENT



TYPE CNA-46188
RADIO RECEIVER



PART REAR VIEW

OUTLINE DRAWING
OF
TYPE CNA-46188 RADIO RECEIVER
WITH
TYPE CNA-10125 MOUNTING BASE

WEIGHTS: RECEIVER - 7¼ POUNDS
MOUNTING BASE - 5¾ POUNDS

NATIONAL CO., INC. MALDEN, MASS.			
MATERIAL		PART NAME	OUTLINE D'WG.
FINISH		FIRST USED ON	RBH-1 EQUIP.
DRAWN M.J.P.	DATE 7-2-42	SCALE Half	DRAWING NUMBER D-857